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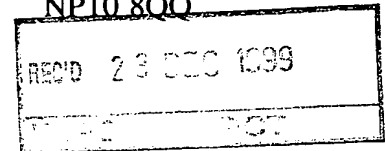
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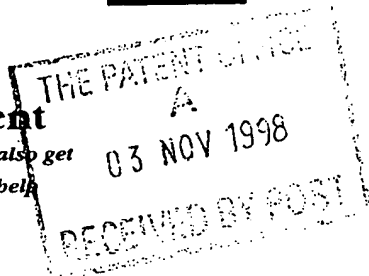
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Cardiff Road  
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1. Your reference

P847

2. Patent application number

(The Patent Office will fill in this part)

9823945.2

- 3 NOV 1998

3. Full name, address and postcode of the or of each applicant (underline all surnames)

DUDLEY BRIAN CROSSING

23 BURN RIVER RISE

VEINE PARK

TORQUAY

DEVON

TQ2 6RH 6927974001

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention

IMPRINT IDENTIFICATION SYSTEM

5. Name of your agent (if you have one)

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

CRASKE & Co.

PATENT LAW CHAMBERS

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EXETER

EX4 4HT

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79 71 004

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Country

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Date of filing  
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

No

a) any applicant named in part 3 is not an inventor, or

b) there is an inventor who is not named as an applicant, or

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See note (d))

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Continuation sheets of this form

Description

Claim(s)

Abstract

Drawing(s)

9 / 1034

2 + 2

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Priority documents

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Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

Request for substantive examination (Patents Form 10/77)

Any other documents (please specify)

11.

I/We request the grant of a patent on the basis of this application.

Signature

C. A. G.

Date

2-11-98

12. Name and daytime telephone number of person to contact in the United Kingdom

Mr SA CRABBE 01392 413479

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Dudley Bryan Crossling

## IMPRINT IDENTIFICATION SYSTEM

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### TECHNICAL FIELD OF THE INVENTION

This invention relates to a method of identifying footwear or other impressions left, for example, at places where crimes have been committed. Although the following description refers specifically to footwear it will be appreciated that the method is also applicable to impressions left by vehicle tyres or tools for example.

### BACKGROUND

WO 97/28 513 discloses a system in which a digital image of a footprint is captured, displayed on a computer screen, cropped to a predetermined size, and the rectangular co-ordinates of any unique identification features are recorded and stored in a database. The stored co-ordinates can then be compared to identify any similar sets of co-ordinates which are likely to originate from the same article. In order to reduce registration errors care must be exercised in the positioning of the image. In addition, in order to take account of any registration errors multiple comparisons are made with the sets of co-ordinates being incremented or decremented between

comparisons.

The present invention seeks to provide an inventive improvement on the earlier system.

### SUMMARY OF THE INVENTION

The present invention proposes a method of imprint identification, comprising:

- obtaining, with a predetermined reproduction ratio, an image from an imprint produced by an article,
- recording the co-ordinates of any unique identification features present in the image,
- calculating the distances between such co-ordinates,
- storing the set of distances thereby obtained in a database record, said database containing a number of similar records obtained from different images, and
- comparing said stored records to identify images likely to originate from the same article.

If the lines joining the co-ordinates are displayed it will be found that they produce a polygon formed of a number of triangles. Each such polygon will be unique to the particular article from which the image was obtained. Moreover, the shape of the polygon as defined by the spatial information (distances) will not change with time and will be independent of the positioning of the image. Thus, by comparing the distance records, imprints

likely to originate from the same article can quickly be identified without the need for multiple comparisons. The requirement for accurate positioning of the image is therefore eliminated and the retrieval speed is greatly improved.

The sets or distances are preferably selected according to defined search parameters covering a range of distances. By adjusting the parameters the number or recovered records can be changed. Thus, by progressively restricting the search parameters the number of records can be progressively reduced until only records likely to originate from the same article are identified.

The records may be displayed in various ways, but it is generally convenient to display the records on separate rows of a spread sheet.

The database preferably includes the images themselves so that the images can be downloaded and visually compared when required. Thus, images possessing similar polygons but different tread patterns can quickly be eliminated since they obviously originate from different articles. The images are preferably stored in a bitmap file. The file header preferably includes identification data such as the location at which the image was obtained and the date.

## BRIEF DESCRIPTION OF THE DRAWINGS

The following description and the accompanying drawings referred to

therein are included by way of non-limiting example in order to illustrate how the invention may be put into practice. In the drawings:

Figure 1 is an image of a footprint as used in the method of the invention, and

Figure 2 is a spread-sheet used to display distance data taken from a number of such images.

#### DETAILED DESCRIPTION OF THE DRAWINGS

A digital image is obtained from a footprint found at the scene of a crime. The image is taken in a fixed reproduction ratio in accordance with any of the techniques described in WO 97/28 513. The image is immediately written to a compact disc (CD) in a bitmap file format for permanent storage so that it can be retrieved for future use, e.g. for production in evidence in criminal proceedings. Examples of suitable bitmap file formats are Windows BMP, TIFF and TGA. To facilitate accurate identification of the image identification data is incorporated into the header of the bitmap file, e.g. the date, time and location where the image was taken. Furthermore, in order to eliminate the possibility of tampering a non-alterable duplicate copy of the image (known as a watermark) is recorded on the CD. The duplicate image cannot normally be displayed except by using secure retrieval software which enables the two images to be overlaid and compared such that and any discrepancy between the two images is highlighted.

In addition to permanent storage the images are subjected to further processing in a way which will now be described. The image is displayed on a computer screen and cropped if necessary to remove any unwanted margins around the footprint. The display resolution is initially set so that the full image is displayed, as shown in Fig. 1. Any characterising marks present in the image are then tagged to record their rectangular (x, y) co-ordinates by positioning a cursor over the mark and clicking with the computer mouse. The kind of features which are recorded generally fall into two categories:

i) Manufacturing (moulding) defects.

ii) Damage caused through wear, such as physical damage (e.g. cuts), inclusions (e.g. pieces of flint or metal), or areas of heavy general wear due to the particular gait of the wearer.

In order to allow more detailed examination of the image and identification of characterising features as well as facilitating more accurate positioning of the cursor within a characterising mark the image can be zoomed by up to 1600% to increase the display resolution of any desired area. It will however be appreciated that magnifying the image in this way does not change the underlying resolution of the stored image. The geometrical centre of irregular areas of damage, e.g. diffuse areas of general wear, can be determined by software sub-routines which auto-trace the contrast boundary between worn and unworn areas of the sole. The number of pixels contained within the area is then calculated and an ellipse is drawn containing the same number of pixels as the traced area. The major axis of

the ellipse is manually aligned with the longest dimension of the traced area, and the point of intersection of the major and minor axes of the ellipse is taken as the notional centre of the respective area.

Different kinds of characterising feature can be tagged with particular identifying symbols (e.g. circle, cross, star etc.). The ability to distinguish between different kinds of feature further enhances the discrimination of the system.

Unless the footwear is virtually new, at least three characterising features will normally be present. In the example shown in Fig. 1 four such features are identified, labelled A to D. When all the features have been tagged, the computer calculates the distances between all of the tagged points. In the case of the image shown in Fig. 1, the four points produce six distance values which are represented by the lines 1 to 6 in the drawing. These lines are not necessarily displayed to the user but they are shown in the drawing to illustrate the polygon which they define.

It will be appreciated that the distance values and the shape of the polygon will be the same irrespective of the positioning of the image, and in fact, even the orientation of the image will not alter the resulting distances. Only the base resolution of the image (e.g. the number of pixels per cm) will affect the distances, but this can be eliminated by ensuring that all images are obtained with a predetermined reproduction ratio (conveniently 1:1). It is possible that this factor could also be eliminated by expressing all of the distances relative to the shortest or longest distance, but this would not allow accurate comparisons to be made over a prolonged period.

The manual tags and polygons are stored as separate files appended to the original image file, and the calculated distance values are added to a central database. Each new set of readings creates a new record in the database. The image is also uploaded to the database together with the appended tag files.

By using appropriate search criteria it is possible to retrieve records which have similar distance values. Initially it will generally be desirable to use broad search criteria, e.g. all distances falling within a small number of defined distance bands. The retrieved records are then conveniently displayed in spread-sheet format, as shown in Fig. 2. Each row of the spread-sheet corresponds to a different record. The search criteria can be progressively narrowed to reduce the number of records until only those likely to originate from the same item of footwear are displayed. By displaying the distance values falling within different bands in different colours it is possible to quickly identify the records most likely to be of interest. For example, in the Figure the values prefixed "R" will be displayed in red, those prefixed "Y" would be yellow, and "B" would be blue. Thus, there are only two records (rows 5 and 6) which contain values falling within all three specified bands, and these records can be selected to allow their examination in more detail.

As the item of footwear ages additional characterising features will be added so that the number of distance values obtained from an image will tend to increase. It is important to appreciate however that the distances between existing features will not change so that sufficient common distance values will still be present to allow accurate retrieval of related records. It is of

course possible that characterising marks will be lost as the footwear ages and shallow features wear away, but again there will generally be a sufficient number of common values remaining to allow reliable retrieval of related records.

When records which might be related have been identified the original bitmap images and tag files can be downloaded for detailed examination. Clearly, any images having similar distance values but different tread patterns can be eliminated at this stage. A manual examination will generally confirm whether the footprints originated from the same item of footwear. The tags and polygons can be superimposed on any image to assist manual comparison and identification of related images.

A second database can be set up as described in the aforementioned patent specification, containing similar data obtained by scanning the footwear of known suspects whilst they are held in custody. Again, the images are added to the second database with identification data recorded in the bitmap file header. Such details include date, time and location of image recording, the name and collar number of the officer who made the recording, the station code, suspects name, custody number, nominal number, shoe make, model, size, offence, and (if desired) other details pertaining to the offence in free text form. It is thus possible, by searching and comparing data from both databases, to link individual offenders to the scenes of crimes at which footprints were retrieved.

In summary therefore, by comparing the distance records, imprints likely to originate from the same article can quickly be identified. The requirement

for accurate positioning of the image is eliminated and the retrieval speed is greatly improved. The image retrieval process does not affect other substances which might be present on a suspects footwear so that it can then be examined for forensic evidence. There is also a significant reduction in running costs compared with existing image retrieval and storage systems.

It will be appreciated that the features disclosed herein may be present in any feasible combination. Whilst the above description lays emphasis on those areas which, in combination, are believed to be new, protection is claimed for any inventive combination of the features disclosed herein.

\* \* \* \* \*

1/2

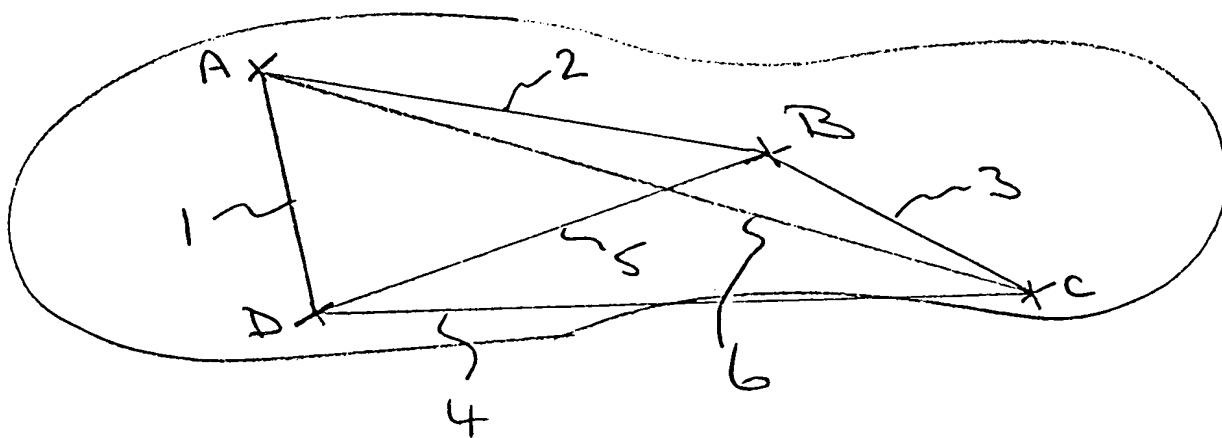


Fig 7

2/2

Scenes													O
S	TH	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	
Soco													
WAW	569.4647	R 339.0295	528.5319	94.82616	847.12719	37.48333							
WAW	577.0139	R 339.2671	532.0489	143.5444	115.447	57.68882	51.89412	847.53946	847.54119				9.055385
WAW	571.4237	R 338.0367	529.5253	139.671	131.0267	83.63014	848.10405						
WAW	577.0078	R 337.2477	533.0375	145.4373	132.9812	115.6936	51.89412	846.57252	846.38965				9
WAW	R 331.1343	532.6434	134.8369	10.04988									
WAW	R 333.8132	541.7906	538.0279	176.1193	106.0424	59.03389	51.86521	842.15448	25.63201				
WAW	569.4647	559.0295	528.5319	94.82616	47.12749	37.48333							
WAW	577.0139	557.2477	532.0489	143.5444	115.447	57.68882	51.89412	47.53946	45.54119				9.055385
WAW	571.4237	558.0367	529.5253	139.671	131.0267	83.63014	48.10405						
WAW	577.0078	557.2477	533.0375	145.4373	132.9812	115.6936	51.89412	46.57252	46.38965				9
WAW	561.1343	532.6434	134.8369	10.04988									
WAW	553.8132	541.7906	538.0279	176.1193	106.0424	59.03389	51.86521	42.15448	25.63201				
Format / Import													

Fig 2

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